Worksheet: Balancing Equations and Classify the Equation

Part 1

Δ

1. \_\_\_KClO3  \_\_\_KCl + \_\_\_\_O2

Δ

2. \_\_\_HgO  \_\_\_Hg + \_\_\_O2

Δ

3. \_\_\_H2O2  \_\_\_H2O + \_\_\_O2

4. \_\_\_Cu + \_\_\_O2  \_\_\_CuO

5. \_\_\_Fe + \_\_\_ HCl  \_\_\_ FeCl2 + \_\_\_H2

6. \_\_\_Mg + \_\_\_N2  \_\_\_ Mg3N2

7. \_\_\_Zn + \_\_\_H2SO4  \_\_\_ZnSO4 + \_\_\_H2

8. \_\_\_C + \_\_\_O2  \_\_\_CO2

9. \_\_\_ Na + \_\_\_HOH  \_\_\_NaOH + \_\_\_H2

10. \_\_\_BaO2 + \_\_\_H2SO4  \_\_\_BaSO4 + \_\_\_H2O2

Δ

11. \_\_\_NaClO3  \_\_\_NaCl + \_\_\_O2

12. \_\_\_BaCl2 + \_\_\_K3PO4  \_\_\_Ba3(PO4)2 + \_\_\_KCl

13. \_\_\_Fe + \_\_\_H2O  \_\_\_Fe3O4 + \_\_\_H2

Part II Change the words into symbols/formulas. Balance the following equations and classify the equations.

1. zinc + silver nitrate  zinc nitrate + silver

2. barium chloride + sodium sulfate  barium sulfate + sodium chloride

3. copper + sulfur  copper(I) sulfide

4. magnesium + sulfuric acid(hydrogen sulfate)  magnesium sulfate + hydrogen gas

5. silver nitrate + ammonium chloride  ammonium nitrate + silver chloride

6. potassium + water  potassium hydroxide + hydrogen gas

7. hydrogen + copper(II) oxide  water + copper

8. calcium + water  calcium hydroxide + hydrogen gas

9. aluminum + hydrogen chloride(hydrochloric acid)  aluminum chloride + hydrogen gas

Worksheet: Balancing Equations

1. calcium + oxygen  calcium oxide

2. phosphorus + chlorine  phosphorus(III) chloride

3. phosphorus + chlorine  phosphorus(V) chloride

Δ

4. potassium chlorate  potassium chloride + oxygen

Δ

5. iron(III) hydroxide  iron(III) oxide + water

Δ

6. hydrogen nitrite(nitrous acid)  hydrogen nitrate(nitric acid) + nitrogen monoxide + water

7. nitrogen(V) oxide + water  nitric acid

8. sodium oxide + water  sodium hydroxide

9. aluminum hydroxide + hydrogen chloride  aluminum chloride + water

10. manganese(IV) oxide + hydrogen chloride(hydrochloric acid)  manganese(III) chloride + water + chlorine

11. iron(III) chloride + hydrogen sulfide  iron(II) chloride + hydrogen chloride + sulfur

12. potassium dichromate + nitrogen dioxide + nitric acid  potassium nitrate + chromiun(III) nitrate + water

13. sulfur + oxygen  sulfur dioxide

14. nitrogen + hydrogen  ammonia

15. hydrogen + chlorine  hydrogen chloride

Δ

16. mercury(II) oxide  mercury + oxygen

Δ

17. nickel(II) chlorate  nickel(II) chloride + oxygen

18. aluminum + hydrogen sulfate(sulfuric acid)  aluminum sulfate + hydrogen

19. potassium iodide + chlorine  potassium chloride + iodine

20. silver nitrate + copper  copper(II) nitrate + silver

Worksheet: Combustion Reactions

a) Write the equation for the combustion of the following organic compounds

b) Balance the equation

c) Put arrows where appropriate

1. Propane (C3H8) 

2. Ethylene (C2H4) 

3. Octane (C8H18(l)) 

4. Methane (CH4) 

5. Acetylene (C2H2) 

6. Heptane (C7H16) 

7. Butane (C4H10) 

4 Types of Reactions

1. Composition(synthesis)

A + X  AX(check charges!!!!)

a. metal + nonmetal  compound

b. nonmetal/metalloid + nonmetal  compound

c. metal oxide + water  hydroxide(base)

----OH

d. nonmetal oxide + water  acid

H----

2. Decomposition(analysis)

AX  A + X

a. metallic carbonate  metal oxide + CO2

b. metallic hydroxide  metal oxide + H2O

c. metallic chlorate  metal chloride + O2

d. some oxide  decompose

2 HgO  2Hg + O2

e. some acids  nonmetal oxide + H2O

f. some decomposition reactions are produced by an electric current.

2 H2O electricity 2 H2 + O2

D.C.

3. Single Replacement

A +XY  X + AY or A + XY  XA + Y

Note: Use the Activity Series Chart

a. replace a metal in a compound by a more active metal

b. replace hydrogen in water by an active metal

Exceptions: Li, K, Ca, Na are so active that they form hydroxides instead of oxides

c. replace hydrogen in an acid by an active metal

d. replace a halogen by a more active halogen

4. Double Replacement

AB + XY  AY + XB

Note: Use the Solubility Chart

a. salt + salt  salt + salt

b. salt + base  salt + base

c. salt + acid  salt + acid

d. acid + base  salt + water

Note: a salt is a positive ion from a base and a negative ion from an acid

Double Replacement

a. replace words with symbols

b. predict reaction or NR

c. indicate precipitates with arrow down and gases with an arrow up

d. balance equations

1. silver nitrate + sodium chloride 

2. lead(II) nitrate + potassium iodide 

3. potassium chloride + sulfuric acid(Hydrogen sulfate) 

4. sodium bromide + phosphoric acid(hydrogen phosphate) 

5. silver acetate + potassium chlorate 

6. potassium hydroxide + hydrogen chloride(hydrochloric acid) 

7. zinc chloride + sulfuric acid 

8. calcium phosphate + sodium nitrate 

9. sodium hydroxide + aluminum chloride 

10. barium nitrate + sulfuric acid 

11. sodium hydroxide + hydrogen nitrate( nitric acid) 

12. sodium hydroxide + copper(II) sulfate 

13. silver acetate + potassium chloride 

14. calcium phosphate + sodium nitrate 

15. cupric chloride + ammonium sulfide 

Single Replacement

a. replace words with symbols and indicate gases with arrows up

b. predict reaction or NR

c. balance equation

1. calcium + water 

2. iron(II) + copper(II) nitrate 

3. zinc + hydrochloric acid 

4. chlorine + sodium bromide 

5. copper(II) + water 

6. bromine + potassium iodide 

7. iron(II) + sulfuric acid 

8. silver + sulfuric acid 

9. bromine + potassium chloride 

10. sodium + water 

11. aluminum + water 

12. silver + hydrochloric acid 

13. chlorine + sodium iodide 

14. bromine + potassium fluoride 

15. magnesium + iron(II) nitrate 

Mixed: Single and Double Replacement

a. replace words with symblols

b. predict reaction or NR

c. indicate precipitates with an arrow down and gases with an arrow up

d. balance equation

e. classify equation as either single or double

1. zinc + hydrochloric acid 

2. bromine + potassium chloride 

3. calcium hydroxide + hydrogen phosphate 

4. aluminum sulfate + calcium hydroxide 

5. calcium + hydrochloric acid 

6. silver + lead(II) acetate 

7. iron(II) sulfide + hydrochloric acid 

8. aluminum + nickel(II) nitrate 

9. silver nitrate + zinc chloride 

10. copper(II) + calcium carbonate 

Composition Reactions(Synthesis Reactions)

a. replace words with symbols

b. predict reactions and indicate gases with arrows up

c. balance equations

1. sulfur trioxide + water 

2. sodium + oxygen 

3. magnesium oxide + water 

4. hydrogen + bromine 

5. carbon + oxygen 

6. copper(II) + chlorine 

7. nitrogen(III) oxide + water 

8. potassium oxide + water 

9. carbon dioxide + water 

10. barium oxide + water 

11. zinc + sulfur 

12. sodium oxide + water 

13. potassium + chlorine 

14. hydrogen + chlorine 

15. nitrogen + hydrogen 

Decomposition Reactions (Analysis Reactions)

a. replace the words with symbols and gases with an arrow up

b. predict reaction c. balance equation

Δ

1. lithium carbonate 

Δ

2. iron(III) hydroxide 

Δ

3. nickel(II) chlorate 

Δ

4. carbonic acid(hydrogen carbonate) 

Δ

5. silver oxide 

6. sodium chloride electricity(D.C.) 

Δ

7. barium carbonate 

Δ

8. zinc hydroxide 

Δ

9. sulfurous acid(hydrogen sulfite) 

Δ

10. mercury(II) hydroxide 

Δ

11. sodium chlorate 

Δ

12. sulfuric acid(hydrogen sulfate) 

Δ

13. magnesium bromide 

Δ

14. carbonous acid(hydrogen carbonite 

Δ

15. calcium hydroxide 

Δ

16. iron (III) oxide 

Mixed:Composition and Decomposition

a. replace words with symbols

b. predict reaction

c. balance equation

d. classify the reaction as either comp or decomp

Δ

1. calcium carbonate 

2. phosphorous(III) + chlorine 

3. sodium + oxygen 

Δ

4. silver oxide 

5. magnesium + oxygen 

6. iron(III) + oxygen 

Δ

7. cadmium(II) carbonate 

Δ

8. lead(II) hydroxide 

9. iron(II) + sulfur 

10. magnesium + nitrogen 

Δ

11. carbonic acid 

Mixed: All 5 Types

a. replace words with symbols

b. predict reaction or NR

c. show precipitates with arrows down and gases with arrows up

d. balance equation

e. classity the reactions as either comp, decomp, single, or double

1. copper(II) oxide + hydrogen  copper + water

2. antimony + water  antimony(III) oxide + hydrogen

3. rhenium + bromine  rhenium(III) bromide

Δ

4. actinium(III) hydroxide  actinium(III) oxide + water

5. radium + carbon  RaC2

Δ

6. ammonium nitrite  water + nitrogen

7. copper + sulfur  copper(I) sulfide

8. silver nitrate + sulfuric acid  silver sulfate + nitric acid(hydrogen nitrate)

Δ

9. ammonium nitrate  water + dinitrogen monoxide

Δ

10. copper(II) carbonate  copper(II) oxide + carbon dioxide

11. C2H4 + oxygen  carbon dioxide + water vapor

Mixed: All 5 Types of Reactions

a. replace words with symbols

b. predict equation or NR

c. indicate precipitates with an arrow down and gases with an arrow up

d. balance equation

e. classify the reaction as either comp, decomp, single or double

1. potassium oxide + water 

2. silver nitrate + zinc chloride 

Δ

3. sulfurous acid(hydrogen sulfite) 

4. copper(II) + calcium carbonate 

5. carbon dioxide + water 

6. sodium + water 

7. iron(II) sulfide + hydrochloric acid 

Δ

8. mercury(II) hydroxide 

9. sodium chloride 

electricity

10. chlorine + sodium bromide 

11. C2H4 + oxygen  carbon dioxide + water vapor

Worksheet: All 5 Types

Come up with a balanced equation to represent the following:

1. A S.R. rxn that produces a base

2. A D.R. rxn to produce two insoluble products

3. A composition(synthesis) rxn to produce an acid

4. A S.R. rxn to produce magnesium

5. A composition rxn to produce sulfuric acid(hydrogen sulfate)

6. A decomposition rxn to produce potassium chloride

7. A D.R. rxn whose products are both soluble

8. A D.R. rxn to produce water

9. A S.R. rxn to produce a halogen gas

10. Any rxn which will change red litmus paper to blue

11. Any combustion reaction of an hydrocarbon

Lab: Double Replacement Reactions

**Purpose**: In this laboratory exercise, you will combine seven different chemicals. You will observe any evidence that a chemical reaction has occurred (precipitate, gas produced, acid-base reaction) and write the chemical equation for those chemical reactions. You will also use the solubility chart to predict whether or not a chemical reaction has occurred and any precipitates that may be formed.

**Procedure**:

1. Mix seven chemicals in the 21 combinations listed on the following sheets.

2. Record any observations that you make during the reaction

3. Write a balanced chemical equation for the reaction. Be sure to indicate precipitates, gases and acid-base reactions.

4. Mix the 7 known chemicals with the unknown chemical assigned to your lab group by your teacher. Identify the unknown chemical by process of elimination from the data obtained from the known reactions

Chemicals Formula

1. Hydrochloric acid

2. Sodium hydroxide

3. Copper (II) sulfate

4. Sodium Carbonate

5. Silver nitrate

6. Potassium chromate

7. Iron (III) chloride

Data Table

Chemicals Combined Observations

1-2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1-3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1-4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1-5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1-6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1-7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2-3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2-4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2-5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2-6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2-7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3-4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3-5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3-6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3-7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4-5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4-6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4-7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5-6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5-7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6-7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Unknown Observations

UK + 1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

UK + 2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

UK + 3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

UK + 4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

UK + 5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

UK + 6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

UK + 7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

For the “B”

1. Briefly explain the difference between composition, decomposition, single and double replacement and combustion reactions.

2. When will a double reaction occur? When will a double reaction not occur?

3. What is your unknown? Defend your answer with at least 3 reasons.

For the “A”

1. Why is silver nitrate dangerous? What other chemicals are dangerous?

2. What does .1 M mean? Compare .1 M HCl and 6 M HCl.

3. Research some of the chemicals used and give information on what they are used for in everyday life.

Lab: Relative Reactivity of Metals

Introduction:

The relative reactivity of a group of metals can be established by comparing the reaction of each metal with a given reagent. A metal might react with a specific reagent or no reaction may occur. On the other hand, a given metal might react with a specific reagent at a different rate than some other metal.

Materials

Test tube

Test tube brush

Test tube rack

Barnes dropping bottles

Steel wool

Unknown metals

6 M HCl

.5 M ZnSO4

.5 M MgSO4

.5 M CuSO4

Procedure:

1. Make observations about the various metals we are studying.

2. Put approximately 5 ml (one good squirt) of your first reagent in a test tube.

3. Clean the first metal strip with steel wool and place the clean metal in the test tube with the reagent.

4. Record your observations in the data table. What do you hear? See? Smell? How does the test tube feel? Is it warm or cold? What does this mean about the reaction?

5. Wait for approximately 1 minute. If nothing occurs, you can assume that a reaction will not take place.

6. Fill your test tube (containing the reagent and metal) with water and dump the contents into the sink. Be sure to catch the metal so it does NOT go down the drain. Rinse the test tube three additional times using a test tube brush. The test tube must be completely clean before you continue with the next reagent.

7. Repeat the process with the remaining reagents.

8. When you are finished with each the reagents, repeat the procedures with your next unknown metal.

Safety!!!!

6 M HCl is VERY dangerous and causes burns. Please take extra precautions NOT to spill it. If you do, you MUST immediately tell the teacher so it is cleaned up properly!

Discussion Questions:

1. Write out the equations for the reactions that actually reacted. Note: There should be 12. (2 are repeats)

2. Rank the metals from strongest to weakest in reactivity.

3. Give some information on the dangerous chemical 6 M HCl. What does the

6 M mean?

4. Explain single replacement reactions. Explain “girl” fights , “boy” fights and NR’s.

For the “A”

1. What should occur when combining magnesium and copper (II) sulfate? Write the equation. Now, suppose a student does not clean the test tube well and uses the product and places a piece of zinc in the previous solution. The student says the zinc didn’t react with the solution. Explain what could account for this? Include the equation that represents this reaction.

2. Research some of the metals and reagents used in this lab. Give some uses for them.

3. A student was investigating four metals, A, B, C, and D. The students reacted the metals with for reagent salts, AZ, BZ, CZ, and DZ. The following results occurred.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Metal | AZ | BZ | CZ | DZ |
| A | NR | NR | NR | NR |
| B | R | NR | R | NR |
| C | R | NR | NR | NR |
| D | R | R | R | NR |

Rank the metals in order of increasing reactivity.

Data Table:

|  |  |  |  |
| --- | --- | --- | --- |
| Metal | Color | Texture | Luster |
| A |  |  |  |
| B |  |  |  |
| C |  |  |  |
| D |  |  |  |
| E |  |  |  |
| F |  |  |  |

Observations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Metal | 6 M HCl | .5 M ZnSO4 | .5 M MgSO4 | .5 M CuSO4 |
| A |  |  |  |  |
| B |  |  |  |  |
| C |  |  |  |  |
| D |  |  |  |  |
| E |  |  |  |  |
| F |  |  |  |  |